Present Concepts of the Epidemiology of Poliomyelitis*

NORMAN NELSON, M.D., *Los Angeles*

POLIOMYELITIS is a most fascinating disease. Probably never in the history of medicine has so much money been spent for research, so much work done, and so many facts elicited on one disease, with so little results.

A disease may be studied experimentally, in the laboratory, or epidemiologically, as it occurs in man. The laboratory worker can control his experiments, but must be careful in carrying his results over to man. For instance, the fact that monkeys are very easily infected by the virus of poliomyelitis by intranasal inoculation has been interpreted to indicate that this is the route of infection in man. The virus of equine encephalitis, however, which we know to be mosquito transmitted, is also infectious by this same route.

The epidemiologist, on the other hand, must accept the disease as it exists. He attempts to determine in whom the disease occurs, under what conditions, and how the individual or his environment may be altered so as to prevent its occurrence. Obviously a close working relationship between the experimentalist and epidemiologist is necessary for the most productive efforts.

ANIMAL EXPERIMENTATION

Animal experimentation in poliomyelitis has been extremely difficult because of the specificity of the virus. Until 1939 when Armstrong[1] adapted the Lansing strain to cotton rats and to white mice, the monkey was the only experimental animal. Because of the expense of running a large series of animals and the consequently limited size of experimental and control groups, many conclusions based on work done up to this time, such as virus neutralization studies, are subject to question. Animal experimentation has, nevertheless, been productive of many important facts. We have been able to isolate and study the virus. We know that it occurs in nasal secretions, that it occurs in enormous quantities in the stools, that there are many strains, and that during an outbreak many people are infected and harbor the virus, but few develop disease.

Recently Milzer and Byrd,[5] using autolyzed mouse brain tissue, have been able to adapt human poliomyelitis virus to white mice. Several blind passages are apparently necessary before recognizable disease occurs in the mice. This outstanding piece of work opens the door to immunologic comparison of different strains, and the possible production of monovalent or polyvalent vaccines of attenuated virus.

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EPIDEMIOLOGY

As a whole the epidemiology of poliomyelitis has been confusing. This writer believes that it is possible, however, to fit the known facts into a pattern that makes sense and points the way to the control of this disease.

Age Distribution

The age distribution of poliomyelitis, as we know it in the United States, is that of a widespread infection. In cities the age incidence is lower than in rural areas, the same as in measles. Thus in New York City in the 1916 epidemic, 78.8 per cent of the cases were under five years and only 3 per cent over 15 years. In rural New York, however, only 45.5 per cent were under five, and 19.1 per cent were over 15.

Virgin soil outbreaks of poliomyelitis,[2,6,7] on the other hand, show two outstanding characteristics not seen in populations previously invaded: (1) a remarkably greater susceptibility to the development of recognizable disease in adults as contrasted to children, and (2) an unusually high rate of recognizable disease in adults. Both of these characteristics are well illustrated by the following figures taken from the report of the New Guinea outbreak studied by Dr. Jean Macnamara of Australia.[7]

Village	Adults (Over Puberty) Cases per 100 population	Children (Birth to Puberty) Cases per 100 population
Mokereng	15.3	0
Papitalai	4.5	0
Loniu	6.1	0.8
Pak	5.8	0
Liap	16.3	2.1

Case Fatality Rate

A study of the case fatality rate of poliomyelitis in Massachusetts 1928-41 corrected for reporting (to be published) shows a case fatality rate under five years of 3.77 per cent and over 15 years of 11.94 per cent. Every clinician who has entered a large communicable disease ward during an epidemic is struck by the number of adults in respirators. Evidently the higher the age at which poliomyelitis is acquired, the more severe is the disease produced.

Age Distribution in Early Poliomyelitis

The earliest accurate descriptions of poliomyelitis are remarkable in two respects; the early age distribution and the absence of epidemics. Heine,[3] in 1840 pointed out that almost all cases of poliomyelitis in his experience occurred in the age group, 6-36 months. This is hardly the picture one sees with the introduction of a new infection. It is rather the

age distribution one sees with the development of specific immunity to an infective organism that is very widespread. The relative immunity of infants under six months of age points to the widespread existence of passive immunity in newborns. All of Medin's 44 cases occurring in Stockholm in 1887[4] were under six years of age, and 35 of the 44 were under three years of age.

The second characteristic of early reports is the absence of epidemics. "No circumstance in the history of the poliomyelitis is so baffling as its change, during the last two decades of the nineteenth century, from a sporadic to an epidemic disease."[8]

No satisfactory explanation of this change has been given. Römer writes on this point: "It is curious that the older literature contains not a single reference to any epidemic, although infantile paralysis most certainly occurred."[8]

In view of the very young age distribution of early poliomyelitis and the absence of epidemics, one is forced to consider the possibility that the effective spread of virus was very high, that infection in the vast majority of instances took place at an early age, that therefore large concentrations of susceptibles were not built up, and that among those infected at that early age, a very low per cent developed recognizable disease.

It is an interesting corollary that, with improvements in general hygiene and sanitation in the past 50 years, the disease has attacked an older age group[9] and has at the same time become an epidemic disease.

Geographic Distribution

It is an interesting fact that the most severe epidemics of poliomyelitis have been reported from the parts of the world where hygiene and sanitation have reached their greatest development. The most remarkable exceptions have occurred in the Philippine Islands and Japan during the past two years. It is significant, however, that most of the recognizable disease in these outbreaks occurred amongst American troops who had been reared under conditions of relatively good sanitation, while the native populations remained relatively free of disease.

One might justifiably point out that reporting would not be as good in areas where sanitation was poor. Certainly, however, large epidemics would be recognized if they occurred, and the literature is remarkably free of mention of large epidemics in areas of the world where sanitation is poor.

Much evidence indicates that the virus of poliomyelitis is present throughout the world, and especially prevalent in areas of poor sanitation. "In the age incidence, as in the neutralization tests, we meet the paradox of the age incidence being lowest where the clinical disease is least prevalent."[10]

Institutional Outbreaks

Recently in Los Angeles a case of poliomyelitis broke out in a dormitory run under conditions of unimaginable filth. One hundred and ninety people, including 99 children under the age of 16, lived in 57 rooms. As many as eight people slept in a room 9x9 feet. There were nine toilets for 168 women and children. As this was obviously inadequate, old tomato cans were used for toilets by many of the children. There was a room 12x18 used as kitchen and dining room. We all expected a major outbreak, and were amazed when no secondary cases occurred. It seemed to us that only a very high general immunity status could have prevented more cases.

A short time before, poliomyelitis had broken out in one of our best run colleges. All the students came from good homes and had been reared under excellent conditions of sanitation. In spite of these conditions, 24 cases developed in a student body of 704.

While the literature is replete with reports of outbreaks of all other infectious diseases in institutions, it is amazingly lacking in reports of major outbreaks of poliomyelitis. Of three major institutional outbreaks of poliomyelitis which have occurred in the Los Angeles area during the past 15 years, all have involved adult groups. It would seem that when the virus infects the younger age groups a very small per cent show evidence of disease; while with the invasion of an older age group, especially one that has been reared under good conditions of sanitation, a much higher rate of recognizable disease occurs.

Relation to Other Diseases

In a recent paper read before the epidemiologic section of the American Public Health Association in Cleveland, Gordon Brown presented evidence to show that a much lower per cent of a group of children who developed recognizable poliomyelitis had antibodies to the Lansing virus than did controls. Zingher[11] in New York City in 1916 showed that 81 per cent of poliomyelitis patients at the Willard Parker Hospital were Schick positive while only 30 to 40 per cent of those in the control group were positive. This finding that children who developed recognizable poliomyelitis have apparently had less exposure to other infectious diseases would indicate that on the average they attain an older age (when more susceptible to the development of disease) before exposure to the virus of poliomyelitis.

CONCLUSIONS

1. The epidemiology of poliomyelitis indicates that it is a disease in which many people are infected but few develop recognizable disease; that a very definite status of acquired immunity to poliomyelitis exists in the population at large. Immunization with a mono or polyvalent vaccine is possible and will some day be perfected—but should be administered at an early age.

2. Epidemics of poliomyelitis have increased throughout the world wherever hygiene and sanitation have allowed the building up of susceptibles.

3. The earlier the age at which infection with the virus of poliomyelitis takes place, the less serious is the disease produced.

4. Our present hygiene and sanitation have not reduced the incidence of poliomyelitis. In fact, it may well be, paradoxically, that we have actually increased the incidence of poliomyelitis disease, while cutting down the general rate of infection through better hygiene and sanitation, by moving the time of original infection into the older age groups.

1734 North Fuller Street, Los Angeles.

DISCUSSION BY WILLIAM McD. HAMMON, M.D.

I would like to make one or two remarks in regard to poliomyelitis. It is certainly true that in a number of areas abroad that were visited by our troops during the war, the disease rate among our troops was higher than it was in our own country, and it also was higher than it was in natives of those areas of a similar age, which would tend to suggest that our troops were less immune than persons in some of these areas who have been brought up under more primitive types of sanitation. That is true of Japan, the Philippines, and North Africa where there was considerable poliomyelitis among American troops.

The British have pointed out that the poliomyelitis rate and the paralytic rate among their officers was considerably higher than among their enlisted men; and that might be due to some of these same factors.

I made a study a couple of years ago in a trailer camp in Marin County, California, where several cases of paralytic poliomyelitis occurred. At the time of the first case, we immediately began a clinic, and we examined practically every child in that trailer camp every other day. We took nose and throat swabs and tested these for poliomyelitis virus, and we particularly studied those taken from children who had any temperature or any other signs of infection.

The only viruses that we isolated in that trailer camp, except frank paralytic infections, which were mostly in adults, were from a smaller list of infants. Those infants were from six months to one and a half years of age, and all had a very minor type of illness. One or two days afterward, a few had a mild fever, but nothing diagnosable as poliomyelitis. And yet a number of the infants in that camp, particularly in the first week in which we began our study, were infected with the poliomyelitis virus.

I would certainly like to support Dr. Nelson's hypothesis —and many of us are thinking along those lines today— that we are losing this important immunizing experience, as far as poliomyelitis is concerned, in our infants, by postponing the age of infection. Of course, at the same time, we are preventing them from having many attacks of diarrhea and dysentery, which are highly fatal in infancy.

QUESTIONS AND ANSWERS

MODERATOR REIMANN: This question is for Dr. Nelson. "What is the 'low down' on the Kenny treatment?"
(Laughter)

DR. NELSON: Well, there isn't any low down on the Kenny treatment. Her main contribution has been to make mechanical-minded physicians more physiological minded. There is, however, no question but that these patients, during the acute stages, are more comfortable.

MODERATOR REIMANN: "What is the present status of the Curare treatment?"

DR. NELSON: I feel very embarrassed, because I think either Dr. Hamilton or Dr. Al Bower should speak about this rather than I. . . . However, I don't think that the Curare treatment has reached a point where we can really give it an evaluation here. There are certain indications for trying the Curare treatment at this time, and out of those indications would be the persistence of a good deal of muscle spasm.

MODERATOR REIMANN: The next question is: "Is it not true that in Los Angeles, a much greater number of cases of poliomyelitis occurred among the Mexican population, which have a lower sanitation, both in Mexico and in Los Angeles, and therefore should have been less predisposed than the white population?"

DR. NELSON: No, that is not true. If anything, it is the other way around. I have been following the statistics very closely in Los Angeles for a good many years, and the highest incidence of recognizable disease has appeared in the white population.

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